Paper Jurnal/Prosiding

by Rani Purbaningtyas

Submission date: 10-May-2023 09:09PM (UTC+0700)
Submission ID: 2089487934
File name: ICE-ELINVO_Nearest.pdf (269.76K)
Word count: 2529
Character count: 11898

Nearest Excellent Potential Location Using Distance Algorithm

R Purbaningtyas and A Arizal
Informatics Department, Engineering Faculty Bhayangkara University of Surabaya,
Street Ahmad Yani No. 114 Surabaya, Indonesia

Email: raniubhara@gmail.com

Abstract. This study aims to find the proper distance calculation method that will be applied to the Sidoarjo on Hands (SoH) application. This study was conducted by comparing three distance algorithms namely Euclidean Distance, Manhattan Distance, and Haversine Formula. The results showed that the Euclidean Distance method was the proper method because this method had has the smallest Mean Absolute Deviation (MAD) with 1.71 in amount.

1. Introduction

Sidoarjo on Hands (SoH) is a mobile-based application which is intended to support Sidoarjo district promotion [1]. This application provides information about excellent potentials in Sidoarjo regency [2]. The SoH application was developed in two stages. The initial stage only displays potential data of Sidoarjo Regency. The second stage is equipped with features of recommended potentials of Sidoarjo Regency which is built by SoH. Furthermore, this stage matches with user's interest [3] and nearest location [4].

These two considerations are critical for users' fulfilling needs. Thus, adding an accurate location calculation relating to the potential displays is necessary.

Nowadays, various algorithms are offered to calculate distance estimation. However, in this paper, we focus on the comparison [5] of three main methods named Euclidean Distance, Manhattan Distance, and Haversine Formula. Then, we can recommend the best method to be implemented in the SoH application based on the smallest difference [6] between the calculation results and the actual distance.

2. Euclidean distance method

The Euclidean Distance method is a calculation between two points in the Euclidean space [7]. Euclidean space was introduced by Euclid, a mathematician from Greece around 300 B.C which focus on a relationship study between angles and distances. This Euclidean connects with Pythagorean Theorem and is applied in 1,2 and 3 dimensions. The formula of Euclidean Distance [8] is as follow:

$$d(x,y) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \quad (1)$$

where x and y are latitude and longitude. The results of this calculation is still in degree units whereas we need km as a distance unit. Thus, we have to adjust the result by multiplying with 111.319 km due to one degree of earth equal to 111.319 km.

3. Manhattan Distance Method

The principle of Manhattan Distance [9] replaces squares in the previous formula by adding the absolute differences from the variables. This procedure is called an absolute block or as known as city block distance.

$$d(x,y) = L_p = i(x,y) = \sum_i^n |x_i - y_i| \quad (2)$$

4. Haversine Formula

We use the Haversine method [10] to calculate the distance between two points angles on the earth's surface using latitude and longitude as input variables. Assuming that the earth is perfectly round with radius R 6371 km, and address of 2 points in the coordinate of the ball (latitude and longitude) are lat1 lon1, and lat2 lon2, then the Haversine formula is written using this equation:

$$d = 2R \sin^{-1} \sqrt{sin^2\left(\frac{\phi_2 - \phi_1}{2}\right) + \cos(\phi_1)\cos(\phi_2)\, sin^2\left(\frac{\psi_2 - \psi_1}{2}\right)} \quad (3)$$

where d is the distance between two points with latitude and longitude (ø,ψ) and R is the radius of the Earth. The Haversine formula is an important equation in navigation [11][12][13].

5. Result and Discussion

This research was conducted in the following stages:

(1) Collecting data by defining the user's starting point to 15 different destination locations
(2) Each starting point and a destination point will be recorded what the value of the coordinates are
(3) Measure the actual distance from the origin point to the destination point
(4) Measure the distance from the starting point to each destination using the Euclidean distance method, Manhattan distance method, and also the Haversine method
(5) Calculate the difference of each algorithm by comparing the actual distance value and the calculated value of the algorithms
(6) Calculating the absolute value of each error of the three methods
(7) Define the finest algorithm based on the smallest value in the calculation error

For comparing the accuracy of calculation between three methods, a user was in Sidoarjo town square with coordinates (-7.446061,112.717707), was given 15 different locations in Sidoarjo regency:

- Location A is Indah Bordir Sidoarjo (-7.444184, 112.720208) with the actual distance from the user's location is 2.4 km
- Location B is Intako Tanggulangin (-7.505345, 112.694379) with the actual distance from the user's location as far as 9.7 km
- Location C is East Java Province Cooperative and MSME Office (-7.381197, 112.741744) with the actual distance from the user's location as far as 11 km
- Location D is Ecco Leather (-7.473713, 112.714597) with the actual distance from the user's location as far as 3.8 km
- Location E is Mitra Jaya (-7.497852, 112.696946) with the actual distance from the user's location as far as 8.2 km
- Location F is Fitrah Jaya (-7.499064, 112.69749) with the actual distance from the user's location as far as 8 km
- Location G is UD Diya Aini Jaya (-7,501568, 112.705614) with the actual distance from the user's location as far as 7 km
- Location H is Gugum Leather Jacket (-7.499108, 112.700124) with the actual distance from the user's location as far as 7.7 km
- Location I is Yokohama Sandal (-7.352664, 112.748203) with the actual distance from the user's location as far as 12.8 km

- Location J is Hasta Indah Bordir (-7.502453, 112.707734) with the actual distance from the user's location as far as 6.8 km
- Location K is Permata Tanggulangin Collection (-7.50287, 112.703678) with the actual distance from the user's location as far as 8 km
- Location L is Maju Makmur (-7.498908, 112.697412) with the actual distance from the user's location as far as 8 km
- Location M is Teratai Indah Bordir (-7.494357, 112.687915) with the actual distance from the user's location as far as 9.6 km
- Location N is Yan Kurin Collection (-7.486597, 112.710988) with the actual distance from the user's location as far as 5.1 km
- Location O is UD New Paulo (-7.404576, 112.723424) with the actual distance from the user's location as far as 6.5 km

5.1. First iteration

For the first destination location, we used Euclidean Distance method, and the result as shown:

$$d(start, A) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$
$$= \sqrt{(-7.446061 - -7.444184)^2 + (112.717707 - 112.720208)^2}$$
$$= 0{,}35 \text{ km}$$

Table 1 depicted the result of 15 locations using Euclidean Distance method

Table 1. Euclidean distance result

Origin	Destination	Actual Distance	Euclidean Distance Result
Start (Sidoarjo town square)	A (Indah Bordir Sidoarjo)	2.4 km	0.35 km
	B (Intako Tanggulangin)	9.7 km	7.08 km
	C (East Java Province Cooperative and MSME Office)	11 km	7.71 km
	D (Ecco Leather)	3.8 km	3.09 km
	E (Mitra Jaya)	8.2 km	7.2 km
	F (Fitrah Jaya)	8 km	6.31 km
	G (UD Diya Aini Jaya)	7 km	6.32 km
	H (Gugum Leather Jacket)	7.7 km	6.21 km
	I (Yokohama Sandal)	12.8 km	10.95 km
	J (Hasta Indah Bordir)	6.8 km	6.37 km
	K (Permata Tanggulangin Collection)	8 km	6.5 km
	L (Maju Makmur)	8 km	6.29 km
	M (Teratai Indah Bordir)	9.6 km	6.31 km
	N (Yan Kurin Collection)	5.1 km	4.56 km
	O (UD New Paulo)	6.5 km	4.67 km

5.2. Second iteration

We calculated using Manhattan Distance method and the result as below. More detail, table 2 showed the measurement of 15 locations

$$d(start, A) = \sum_i^n |x_i - y_i|$$
$$= |-7.446061 - -7.444184| + |112.717707 - 112.720208|$$
$$= 0.5 \text{ km}$$

Table 2. Manhattan distance result

Origin	Destination	Actual Distance	Manhattan Distance Result
Start (Sidoarjo town square)	A (Indah Bordir Sidoarjo)	2.4 km	0.5 km
	B (Intako Tanggulangin)	9.7 km	9.19 km
	C (East Java Province Cooperative and MSME Office)	11 km	9.91 km
	D (Ecco Leather)	3.8 km	3,42 km
	E (Mitra Jaya)	8.2 km	8,07 km
	F (Fitrah Jaya)	8 km	8.14 km
	G (UD Diya Aini Jaya)	7 km	7.52 km
	H (Gugum Leather Jacket)	7.7 km	7.85 km
	I (Yokohama Sandal)	12.8 km	13.8 km
	J (Hasta Indah Bordir)	6.8 km	7.38 km
	K (Permata Tanggulangin Collection)	8 km	7.88 km
	L (Maju Makmur)	8 km	8.13 km
	M (Teratai Indah Bordir)	9.6 km	8.68 km
	N (Yan Kurin Collection)	5.1 km	5.25 km
	O (UD New Paulo)	6.5 km	5.26 km

5.3. Third iteration

For the first destination, when we measured using the Haversine Formula (3) method, the result was 0.35 km. Thus, for all destination, if measured using the Haversine Formula method, the calculation results are follows:

Table 3. Haversine Formula Result

Origin	Destination	Actual Distance	Haversine Formula Result
Start (Sidoarjo town square)	A (Indah Bordir Sidoarjo)	2.4 km	0.35 km
	B (Intako Tanggulangin)	9.7 km	7.01 km
	C (East Java Province Cooperative and MSME Office)	11 km	7.70 km
	D (Ecco Leather)	3.8 km	3.08 km
	E (Mitra Jaya)	8.2 km	6.19 km
	F (Fitrah Jaya)	8 km	6.29 km
	G (UD Diya Aini Jaya)	7 km	6.31 km
	H (Gugum Leather Jacket)	7.7 km	6.2 km
	I (Yokohama Sandal)	12.8 km	10.92 km
	J (Hasta Indah Bordir)	6.8 km	6.36 km
	K (Permata Tanggulangin Collection)	8 km	6.49 km
	L (Maju Makmur)	8 km	6.28 km
	M (Teratai Indah Bordir)	9.6 km	6.29 km
	N (Yan Kurin Collection)	5.1 km	4.56 km
	O (UD New Paulo)	6.5 km	4.66 km

5.4. Final result determination

The finest algorithm will be determined using the Mean Absolute Deviation (MAD) method [14]. MAD is a procedure for measuring the accuracy of the results of calculations with an average error (absolute value of each error) [15]. The formula for calculating MAD values below:

$$MAD = \frac{\sum_{i=1}^{n} |x_i - d_i|}{n} \quad (4)$$

where x is the actual distance data and d is the distance data obtained from the calculation results. The results of distance computation errors with the MAD method are as follows:

Table 4. MAD calculation

Origin	Destination	Actual Distance	Error in Computation Results		
			Euclidean Distance	Manhattan Distance	Haversine Formula
Start (Sidoarjo town square)	A (Indah Bordir Sidoarjo)	2.4 km	-2.05	-1.90	-2.05
	B (Intako Tanggulangin)	9.7 km	-2.62	-18.89	-2.63
	C (East Java Province Cooperative and MSME Office)	11 km	-3.29	-1.09	-3.31
	D (Ecco Leather)	3.8 km	-0,71	-7,22	-0,72
	E (Mitra Jaya)	8.2 km	-2,00	-16,27	-2,01
	F (Fitrah Jaya)	8 km	-1,69	-16,14	-1,71
	G (UD Diya Aini Jaya)	7 km	-0,68	-14,52	-0,69
	H (Gugum Leather Jacket)	7.7 km	-1,49	-15,55	-1,50
	I (Yokohama Sandal)	12.8 km	-1,85	1,00	-1,88
	J (Hasta Indah Bordir)	6.8 km	-0,43	-14,18	-0,44
	K (Permata Tanggulangin Collection)	8 km	-1,49	-15,88	-1,51
	L (Maju Makmur)	8 km	-1,71	-16,13	-1,72
	M (Teratai Indah Bordir)	9.6 km	-3,29	-18,28	-3,31
	N (Yan Kurin Collection)	5.1 km	-0,54	-10,35	-0,54
	O (UD New Paulo)	6.5 km	-1,83	-1,24	-1,84
	Mean Absolute Deviation (MAD)		1,71	11.11	1.72

According to Table 4, Euclidean Distance method has the smallest MAD value when it is compared to Manhattan Distance and Haversine Formula. Euclidean Distance method has an average error (difference) 1.71. It can be concluded that the Euclidean Distance method is more appropriate for SoH application.

6. Conclusion

The Sidoarjo on Hands (SoH) application is a mobile-based application intended to support the promotion of the Sidoarjo Regency. This application was developed in stages. In the final development phase, will be added a feature to display information about the distance from the current location of the SoH users to the location of the potential of the intended area. This study tries to find the most appropriate distance calculation method by comparing the three distance algorithms, namely Euclidean Distance, Manhattan Distance, and Haversine Formula method. The results show that the Euclidean Distance method is the proper method to be applied in SoH application. The most noticeable reason because this method has the smallest value in the calculation error of the distance obtained compared to the actual distance value.

7. References

[1] R. Purbaningtyas *et all* 2017 *Pros. SNATIF* 291–296
[2] R. Purbaningtyas *et all* 2017 *J. Penelit. Pos dan Inform.* **7** 87-96
[3] R. Purbaningtyas *et all* 2018 *Pros. SENTIKA* 181-188
[4] R. Purbaningtyas *et all* 2019 *Probl. Inf. Technol.* **10** 70–76
[5] L. Greche *et all* 2017 *Proc. Int. Conf. on Wireless Technologies, Embedded and Intelligent Systems (WITS)* 1–4

[6] M. Cruz López-de-los-Mozos *et all* 2001 *Eur. J. Oper. Res.* **135** 184–194
[7] D. Nugraheny 2017 *Angkasa J. Ilm. Bid. Teknol.* **7** 21-30
[8] I. Dokmanic *et all* 2015 *IEEE Signal Process. Mag.* **32** 12–30
[9] W.-Y. Chiu *et all* 2016 *IEEE Trans. Evol. Comput.* **20** 972–985
[10] N. Chopde *et all* 2013 *International Journal of Engineering Research and Applications (IJERA)* **1** 162-165
[11] E. Winarno *et all* 2017 *International Conference on Innovative and Creative Information Technology (ICITech)*. 1–4
[12] M. Basyir *et all* 2018 *Emit. Int. J. Eng. Technol.* **5** 270-278
[13] Z. Arifin *et all* 2016 *Proc* 3rd *International Conference on Information Technology, Computer, and Electrical Engineering (ICITACEE)* 293–296
[14] M. Rahmani *et all* 2017 Transp. *Res. Part C Emerg. Technol.* **85** 628–643
[15] C. E. Simpkins *et all* 2017 *Ecol. Inform.* **38** 1–11

Acknowledgments
Thanks to the DRPM of the Ministry of Research and Higher Education of the Republic of Indonesia for funding this research through Individual National Strategic Research schemes in 2018.

Paper Jurnal/Prosiding

ORIGINALITY REPORT

22%	19%	14%	16%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Christchurch Polytechnic Institute of Technology Student Paper	5%
2	Submitted to Program Pascasarjana Universitas Negeri Yogyakarta Student Paper	4%
3	jpit.az Internet Source	3%
4	repository.unej.ac.id Internet Source	2%
5	Ayu Cahyany Arrumdany, Putri Perdana Sari, Paet Rahmadani, Ahmadi Irhamsyah Lubis. "Web-Based Geographic Information System (GIS) in Determining Shortest Path of MSME Medan City Using Bellman-Ford Algorithm", Journal of Physics: Conference Series, 2019 Publication	2%
6	iopscience.iop.org Internet Source	2%
7	computerauswertung.at Internet Source	

2%

8	Submitted to University of Portsmouth Student Paper	1%
9	Submitted to University of Lancaster Student Paper	1%
10	B Setiyono, R D Susanti, DR Sulistyaningrum, IGN Usadha. "Classification and Counting of Moving Vehicle at Night with Similarity of Rear Lamp", Journal of Physics: Conference Series, 2020 Publication	1%
11	xy93.co-aol.com Internet Source	1%

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	On		